DOCUMENT RESUME

ED 232 865 SE 042 639

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TITLE Energy Conservation Education: Program Evaluation Design Considerations.
PUB DATE Oct 82
NOTE 19p.; Paper presented at the Joint Meeting of Evaluation Research Society and Evaluation Network (Baltimore, MD, October 30, 1982).
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150) -- Information Analyses (070)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Conferences; *Conservation Education; Curriculum Evaluation; *Energy Conservation; Environmental Education; *Evaluation Methods; Inservice Teacher Education; Literature Reviews; Motivation; *Program Descriptions; Program Development; *Program Evaluation; *Research Design; Research Methodology; Workshops
IDENTIFIERS *Energy Education

ABSTRACT

This paper provides: (1) a statement regarding the political context for energy conservation education programs; (2) a brief description of the types of program efforts reflected in the literature; (3) an overview of the purposes and approaches to energy conservation education program evaluation reflected in available literature; and (4) a discussion of evaluation design challenges that face energy conservation program evaluators. Program efforts discussed include: classroom curriculum units for schools; conferences for planners and public officials; workshops for homeowners and others; energy fairs and exhibits; mass media, interorganization networks, and consulting (including energy audits). Evaluation design challenges considered include multiple sponsorship, assumptions about conservation motivation, energy use measurement, social desirability bias, and interpretation of findings; each of these areas is described along with approaches used to make findings/interpretations useful for program decision-making. It is indicated that the effectiveness and feasibility of programs described depends on the quality of program evaluations performed and that the design challenges considered need to be addressed with care. (Author/JN)

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EC232865

ENERGY CONSERVATION EDUCATION: PROGRAM EVALUATION DESIGN CONSIDERATIONS

Paper presented at the
1982 Joint Meeting of Evaluation Research Society
and Evaluation Network

October 30, 1982
Baltimore, MD.

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INTRODUCTION

This paper provides: 1) a statement regarding the political context for energy conservation education programs; 2) a brief description of the types of program efforts reflected in the literature; 3) an overview of the purposes and approaches reflected in available literature; and 4) a discussion of evaluation design challenges that face energy conservation education program evaluators.

POLITICAL CONTEXT

Public policy makers appear to be divided over approaches to achieving a decrease in consumption of energy in the United States. Some favor technological solutions that do not require user changes of lifestyle but require centralized capital investments in research and production such as nuclear power or synthetic fuel technologies. Others favor the promotion of alternative technological approaches that can be controlled by the consumer. A third group favors an economic approach that forces the reduction of energy use by allowing prices to rise according to market demands or by providing rebates in the form of tax credits, cash reimbursements or matching grants to those who switch to energy efficient technology. A fourth group views energy conservation, not only as a technological and economic problem, but also as an educational problem claiming that lifestyle and attitude changes are essential to behavior changes. Following the National Energy Act of 1978, a small amount of federal allocations compared to the other strategies were provided for educational approaches. Program evaluators of energy conservation programs have been challenged to show the efficacy of education for energy conservation. This paper does not argue the efficacy of the educational strategy. However, it does describe types of programs, various purposes and approaches to program evaluation design, and considerations that confront evaluators who are working within the above mentioned political context.

TYPES OF PROGRAMS

A variety of educational approaches have been undertaken since the passage of the National Energy Act of 1978. The United States Department of Energy instituted a ten-state university extension pilot program of the Energy Extension Service to train staff from utilities, community agencies

and local government to make on-site energy audits and encourage conservation by small energy users (Department of Energy, 1979). Many state governments have in turn, responded with energy conservation programs, some of which have provided funds for energy education activities. An example is the New York State Home Insulation and Energy Conservation Act (HIECA) (New York State Public Service Commission, 1980). Programs have been sponsored by the public schools, community education, utility companies, state energy offices and extension services, Cooperative Extension, county and local government, volunteer associations and citizen action groups. Activity structures include: 1) classroom curriculum units for schools; 2) conferences for planners and public officials; 3) workshops for homeowners, contractors, business owners and managers; 4) energy fairs and exhibits for homeowners and tenants; 5) mass media newsletters, hot lines, radio and T.V. spots, bulletins and pamphlets; 6) inter-organization task forces, networks and councils; and 7) consulting in conjunction with energy audits for home owners as well as retail, industrial and agricultural business. Program evaluation findings have yet to be synthesized from the many separate and diverse implementation efforts. A meta evaluation of current studies is probably premature due to the fact that relatively few summative efforts have been published.

PURPOSES AND APPROACHES

The brief review which follows does not purport to be comprehensive but rather illustrative of the range of purposes and approaches to energy conservation education evaluation that were uncovered by scanning abstracts from data files and reviewing relevant studies. Judgments about adequacy of methology have been intentionally withheld.

Planning

Surveys by Mindick (1979) and Development Sciences Inc. (1980) illustrate approaches to collection of evaluative data for the purpose of determining options for planning further energy conservation education programs. Mindick gathered information on attitudes and assessment of need among units of state and local government in the State of Arizona. Another planning study (Development Sciences Incorporated, 1980) was carried out to determine options and alternatives for the Education Programs Division (EPD) of the

United States Department of Energy (DOE). In this study, a representative sample of opinions and views of relevant government, academic and private sector agencies and organizations was obtained. Interview data along with literature from memoranda, brochures, program statements, school-enrollment data were analyzed. The study concluded that a wide range of public and private institutions are actively involved in the energy education field but that the public was not being effectively reached due to efforts being unfocused and the public having become resistent to traditional means of education.

Inservice Education Evaluation

New education efforts in schools usually begin with attempts to change teacher behaviors through inservice education. The Farnsworth and Gardner (1978) study, for example, focused on attitude change concerning the energy crisis and increased energy teaching along with personal conservation on the part of the teachers. Findings were positive to all of these objectives when follow-up surveys were conducted via self report questionnaires. Another example of studies focused on teachers was conducted by Kushler and Davidson (1980). They reported that both workshops and individual consultations were successful influencing teachers to include energy conservation instruction in their classes. Impact of teacher efforts on student attitudes and self-reported behavior change was reported as mixed and encouraging.

Curriculum Evaluation

Examples of efforts to evaluate curricula are found in studies by Battelle Columbus Labs (1979), Kodi (1980), and Miller (1980). The Battelle study focused on DOE education curriculum materials that have been used in kindergarten through twelth grades. Most of the data consists of teacher perceptions. Little attention has been given to changes in student skills, knowledge and behavior as a result of exposure to curriculum materials (Battelle Columbus Labs, 1979 p. iii). Kodi evaluated curriculum materials for the Project for an Energy Enriched Curriculum (PEEC) at the University of Maryland and detected some variations in reading levels from those intended. Miller and others followed-up on the Battelle study in order to evaluate the use of the DOE curriculum materials, findings, that the

materials were receiving only limited use because of low teacher awareness of availability. In addition they recommended that DOE evaluation focus on the effect of materials on students rather than on teacher impressions.

Company Energy Management Evaluation

In order to determine the extent of energy conservation effort being spent by companies in the United States and Canada, Thomas (1981) surveyed a sample of 500 companies of the Administrative Management Society. Questionnaires were returned from 311 respondents representing 166 large, 92 medium and 53 small (100 or less employees). These companies represented, 32% manufacturing, 21% service, 11% utility, 7% wholesale and 22% other. Over 55% have some energy program and 18% are planning to have one. Over 54% have had energy audits conducted. Over 1/4th have changed manufacturing processes, 5.5% changed work scheduling, and 4% offer bonuses to employees for saving energy.

Effectiveness of Educational Approaches

Evaluations to determine the effectiveness of educational approaches are far from extensive in the literature. In order to encourage evaluation, the U.S. Department of energy has published procedures for evaluating the effectiveness of federal energy education in its second annual Comprehensive Program and Plan for Federal Energy Education (DOE, 1979). Procedures call for evaluation that is sensitive to the total environment of the energy outreach program. Information should be collected from both clients and organizations and must involve several levels of analysis. In addition to being clear and objective, studies should reflect sensitivity to realistic expectations and secondary impacts of programs. The report does not advocate a single evaluation model but suggests that designs should be taylored to each program at the outset of implementation. Data collection should include: 1) degree of client response to services; 2) impact of services on client; 3) amount of energy saved; and 4) cost-effectiveness associated with cash level of service (DOE, 1979, p 25).

The following studies reflect several approaches which incorporate some or most of the aspects described above. Driscoll and Deshler (1980)

evaluated a community conference on energy conservation. Reactions to the conference were collected at the end of the conference. Telephone interviews were conducted with a sample of individual participants using Scriven's goal-free evaluation approach (1972) in order to identify a broad range of consequences and subsequent energy related action. Effects on participating sponsors and organizations were also identified. The establishment of an organizational network that resulted from the conference led to additional organizational efforts using mass media and the distribution of energy conservation kits for home owners (Manheim, 1981). The work of Smith, Townsend, Hebert and Masteryanni (1981) also represents an effort to evaluate the effectiveness of the public exposition approach to energy conservation. On-site evaluation data were collected along with a six-month impact assessment that compared responses from participants at three expositions with a control group that did not attend the expositions. Those who attended the exposition perceived the energy problem to be more serious, and they [illegible] made significantly (α.05) more implementations than those in the control group. The expositions were considered to be effective in providing practical ideas or suggestions.

The effectiveness of paraprofessionals as consultants to low income families for weatherization programs was the focus of work by Braun and Murry (1978) and by Williams, Braun and Lauener (1981). They trained Expanded Food and Nutrition Education Program (EFNEP) aids in weatherization and found that while the printed media was not found to be an effective method the home visit approach, especially by a paraprofessional known to the family, was successful in getting most of the families to take some conservation action as a result of this effort. The project involved 780 families during a five month period and the follow-up survey included 656 participants.

The effectiveness of the energy audit has received mixed reviews according to Gorzelnik (1980) who reports that although consumers take conservation actions and view the audits as successful, reports from utility companies fail to show much decline in energy use. The March 1981 directive that requires utility companies to provide audits appears on the surface to be positive, however, one could very well wonder about the degree of enthusiasm that utilities have shown toward audits considering a possible

conflict of interest. Driscoll (1981) found much less than enthusiasm on the part of a utility company in contacting people who said that they wanted an audit. On the other hand Harp (1982) in a study of the effectiveness of Cooperative Extension agents trained to conduct energy audits in 645 housing units, reports impressive results but that the costs of time and budget constraints did not permit them to expand the effort in the State of Oklahoma. Another study (Deshler and Keith, 1982) also found the energy audit for small business to be very effective, especially if it is combined with urban renewal grants so that energy improvements could be made at the same time as remodeling for cosmetic and structural purposes. In addition, workshops or seminars for small commercial businesses based on information provided by the New York State Energy Office (1978) was also found to be effective in bringing about some energy reductions according to a New York State Energy Office Evaluation (1982) and according to the above mentioned study by Deshler and Keith (1982).

The only study known to the authors on the effectiveness of energy tours was conducted by Stowe (1982) using the Reflective Appraisal of Programs (RAP) approach designed by Bennett (1982). Energy tours were perceived as very beneficial by over 80% of those participating three different years.

Most of the effectiveness oriented studies mentioned above attempted to gather data on client responses to the educational approach and to obtain evidence that clients had taken action. The amount of energy saved was difficult to ascertain in most studies. This issue will be addressed later in this paper. The cost effectiveness of the educational approach was less often addressed. The state of the art is still not well advanced but studies are pointing to the need to taylor approaches to fit specific types and situations of clients. Energy educators may benefit from reading the U.S. Department of Energy's Final Report on the Midwest Energy Education Consortium (1982) which describes past efforts in the states of Illinois, Indiana, Minnesota, Ohio, and Wisconsin.

DESIGN CHALLENGES

The following design challenges and situations have confronted the authors as part of several summative evaluation studies of energy conservation education programs beyond the public school arena. Each will be briefly described along with the approaches used to make findings and interpretations useful for program decision-making.

Multiple Sponsorship and the Selection of Criteria

It is not unusual for energy conservation education programs to be co-sponsored. Some implementations such as the formation of resource or curriculum networks may involve up to several dozen participating organizations. When their collective efforts are to be evaluated, concern for the selection of criteria mounts in relationship to the diverse purposes of each organization's motivation for participation. A responsive evaluation approach has been useful in the design of evaluations for co-sponsored programs. The use of elite and specialized interviewing (Dexter, 1970), with significant users of the evaluation findings has been helpful in identifying criteria and appropriate data to be gathered and in appreciating the variety of critical uses for the findings.

Assumptions about Conservation Motivation

Evaluation designers can assume all uncritical explanations regarding human motivation for making a change in least in part as a consequence of an educational effort. The most popular assumption is that people want to save money. (Stern, (1976), Barnaby and Peizenstein (1975) and Honnold and Nelson (1978) have conducted studies that confirm that as prices increase, conservation efforts also increase. On the other hand, Battalio (1976) found that a price change in combination with weekly feedback on consumption had no effect on actual comsumption. Selgiman and Darley (1978) however, reported the opposite. However, Driscoll (1980) found that price increases affected older people and income levels differentially. Those who were on lower incomes had already conserved and a price raise did not affect their usage as much.

In regard to the effectiveness of rebates on motivation, Hayes and Cone (1977), Winnett, et al (1978) and Walker (1979) all reported this to be an effective strategy while Stern (1976) reported that direct payoffs for conservation were ineffective. Nevertheless, by 1979, a total of 10,726,751 tax credit claims near one billion dollars had been filed for Federal Income Tax Credits (Bureau of National Affairs, 1980). There have been more than a few who have responded to rebates. Milstein (1977) stated that while a conservation ethic or patriotism are not likely to induce energy conservation, a chance to save money will.

Another motivation is group pressure. Pallak and Cummings (1976) found that homeowners who have made a public commitment to conserve follow through more than those who do not. Stern and Kirkpatrick (1977) also found that existing influence on groups rather than on individuals was effective.

Avoidance of a noxious or severe shortage appears to be a motivation only if the crises is believed to be real and imminent according to Hass, Bagley and Rogers (1975) and Gottieb (1976). Spot messages without detailed information about long term consequences appear to have little affect on conservation motivation (Stern, 1976; Hogan, 1976).

These references are enough to alert the program evaluator to the fact that the evidence concerning motivation is certainly not all in and that evaluations should continue to be open to new evidence that differentiates among various population sectors. For instance, in a current study of the effects of energy education on small business owners it was found that a significant number of owners were motivated to conserve out of a "get the bastards" grudge against the utility companies. Their conservation behaviors in some cases went far beyond what was financially feasible (Deshler and Keith, 1982). This motivation was not conceptualized at the outset of the study, however, it was forced on the researchers when open-ended inquiry was used during on-sight interviews.

Energy Use Measurement

Among many of the evaluations cited above, data concerning conservation actions were collected. Such self-report data is impressive but it is difficult to translate into actual BTUs or Kilowatt Hours saved. Deshler

and Keith (1982) found that informants usually did not closely monitor energy consumption as shown on their monthly bills nor did they know very well how to read them. They tended to compare the monitary figure on their bills from month to month without noting consumption usage. To calculate actual energy savings, it is necessary to have data on actual energy consumption. Some home or business owners do save the portions of their energy bills that give this figure, and have such bills readily available and are glad to share them with an interested investigator. Others, may say they have or think they have them "around here someplace." Some informants are suspicious regarding financial questions and its not worth the search for them to respond to a research need. Asking for this information from energy suppliers involves similar resistances as well as the necessity of getting a release of information from the consumer.

Since energy use varies with yearly weather conditions, longitudinal data for more than several years are required in order to attribute major results to a particular conservation activity. Such studies are unknown to the present authors.

A report by the New York State Energy Office, "Discussion of Program Evaluation Efforts" (1982), is instructive regarding the problems associated with collecting data on BTU consumption:

> It is time consuming and expensive; data is often unavailable, or participants are often unwilling to make information available. For an accurate empirical study, a control group would need to be solicited, and collecting data from that group would be even more difficult.
>
> People who do keep accurate records do not tend to be representative of the general population. Those unwilling to reveal information tend to be those who have not made any conservation efforts.
>
> Asking individuals for their own estimates of energy savings is likely to yield limited data of questionable accuracy.
>
> Shifts and fluctuations in business activity are likely to affect energy usage, and participants are often reluctant to furnish this data (p. 2).

If it is desirable to collect data on the subsequent energy usage of those who have been educated through energy conservation programs, the

importance of collecting this data needs to be stressed to the program participants, and some convenient means of recording the information needs to be offered to them. A hypothetical example: distribution to program participants of a calendar with a chart for marking off, as the bills come in each month, units of gas, electricity, and oil consumed, as well as a sampling of average temperatures, notes concerning fluctuations in business or production that might affect energy use, etc. It would then be a relatively simple matter to collect this data once or twice a year. Another possibility, previously mentioned, is that energy suppliers should be able to change, at relatively little cost, their computerized billing format to provide their customers with a printout or graph of actual energy consumption for each month of a twelve month period. This would give the customer immediate feedback on his energy usage, and greatly increase the general availibility of data on energy consumption, thus increasing program evaluators' chances of procuring accurate and useful information of this kind.

In the general absence of empirical data, methods have been used to predict energy savings which will result from various energy conservation actions; for example, those used in the NYSEO "handbook" (Saving Energy Dollars: An Energy Action Plan For Small Commercial Buildings; New York State Energy Office). Methods have also been used to estimate energy savings which have resulted from participation in energy conservation programs, such as those found in the NYSEO evaluation of the statewide energy conservation seminars (Evaluation of the Energy Conservation Seminars For Small Commercial Businesses; New York State Energy Office; March, 1982).

Predictive formulas are generally constructed by engineers from a combination of field and laboratory data. However, the large number of uncontrolable variables affecting energy use in each specific situation affects the resultant accuracy of the method in use. The unit upon which the estimate is based, e.g., square footage of building or BTU consumption, also affects the result. Applying the two methods mentioned above to those cases among the contacts in which BTU consumption could at least be inferred, and square footage was known, produces dramatically different estimates. Usually, the NYSEO "handbook" estimate is higher than the NYSEO evaluation estimate: in one case, seven times higher.

The NYSEO evaluation methods were intended for use with aggregate data, and are not recommended for predicting energy savings in specific cases. On the other hand, the NYSEO "handbook" method makes specific predictions of energy savings based on the type of energy action taken, and usually based on BTU consumption, but sometimes employing in the calculations square footage of the building or wattage ratings of lights and appliances. However, especially in cases where the owner has undertaken many energy conservation measures, the NYSEO "handbook" methods lead to sometimes astoundingly high savings estimates: 55% in the case of at least one of the contacts, but theoretically it could approach 100%. It was for this reason that the designers of the NYSEO evaluation scaled down their estimations to reflect what they and their consultants believed was probably a "reasonable" 15% maximum savings in energy consumption for "at least one" energy conservation action taken in the area of heating or lighting, and a 10% savings for "at least one" miscellaneous energy conservation action. "At least one" means one or any number of energy related improvements; e.g., from putting in a few low-watt lightbulbs to retrofitting the entire lighting system. Neither of these methods of estimation have been empirically validated.

It may well be that the NYSEO "handbook" methods produce overestimations while in cases of changes to older buildings the NYSEO evaluation formulas produce estimates that are rediculously low for the extent of energy related improvements that an owner has undertaken. These formulas, however, are the present state of the art in the absense of better methods for obtaining accurate energy consumption data.

Social Desirability Bias

Within the last five years a great amount of mass media effort has created an awareness of negative social norms related to energy waste. This probably affects informant responses in the form of social desirability bias. This may be reflected in the almost unanimous findings of most evaluation studies that informants expressed a very positive attitude toward energy conservation. What has not been tested in the studies reviewed for this paper is whether this positive attitude is linked with exagerated claims of implementation from self-report data. Only on-site verification could

answer this concern.

Interpretation of Findings

If you view program evaluation according to Steele (1973, p. 22) as a generalizable process of forming judgments about programs using criteria or standards of comparison and description of what occured and resulted in the program then several problems arise in making judgments and interpreting the findings of energy conservation education evaluations. Another way of stating this concern is to ask what would constitute excellent findings. There are at least five judgment perspectives that can be identified from which the same findings can be interpreted. They are shown in Table I below:

Table I. Program Evaluation Judgment Perspectives

Standard Referenced Judgments -

Include comparisons with value scales, objective; cost benefit ratios and judgments of experts.

Cohort Referenced Judgments -

Include comparisons with similar programs elsewhere.

Alternative Referenced Judgments -

Include comparisons with alternative approaches and potential results if resources were differently used.

Progress Referenced Judgments -

Include comparisons with previous performance of the same program.

Difficulty Referenced Judgments

Include comparisons of the achievement with the difficulty presented by the contexts in which the program operated.

In well established educational settings where standards have become accepted there is little difficulty in using standard referenced judgment perspectives to interpret the degree of excellence achieved by a particular program based on findings. Farmer, Deshler, and Williams (1973) have provided a framework for establishing value scales. Concensus concerning standards

have yet to be established relative to energy conservation education results with the possible exception that programs should at least be cost effective. As more studies appear, similar approaches can be compared using cohort referenced judgments. Alternative approaches are still being tried with mixed results so alternative referenced judgments, although valuable, are not likely to appear very soon until more evaluation studies are published. Progress referenced judgments are quite possible and could be helpful to the state of the art of implementation if program efforts continue long enough to warrant a repeat evaluation. Difficulty referenced evaluations require attention to context and unfortunately many studies do not tell us much about their context's affect on the results. Using the same findings, interpretations from various perspectives could yield a more comprehensive judgment of a particular program effort.

This concern for the interpretation of findings is particularly problematical for new developmental programs such as those which this paper examined. With the use of judgment perspectives, findings may be less likely to be seen as free floating leaves that have left the tree.

SUMMARY

Education may or may not be an essential ingredient to the reduction of energy use in the United States. Whether, public school classes, workshops, seminars, energy tours, conferences, exhibitions and fairs, mass media, inter-organization networks, or consulting and energy audits are conclusively found to be effective and feasible depends on the quality of its program evaluations performed. Design challenges concerning multiple sponsorship, conservation motivation, energy use measurement social desirability bias, and interpretation of findings will need to be addressed with care. The research reviewed in this paper has provided an impressive start.

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